EVALUATION OF NUTRITIONAL STATUS OF PATIENTS USING LABORATORY TESTS. REVIEW

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ABSTRACT

Malnutrition is a condition resulting from the lack of absorption or consumption of nutritional substances, leading to changes in body composition, physical and mental impairment of bodily functions, and adverse effects on the treatment of any underlying disease. In Poland, since 2012, assessing the nutritional status of each patient admitted to hospital is required, the exception of hospital emergency departments. However, there is no gold standard for this assessment. Currently, the main diagnostic criteria are anthropometric measurements and an interview with questions related to nutrition. There are some situations in which checking biochemical markers of malnutrition would be extremely helpful for correct diagnosis.

BACKGROUND

Malnutrition is not only an independent disease, but it is also a very important problem in people suffering from other comorbid diseases. Numerous studies have shown that patient malnutrition may be associated with a longer stay in hospital, more readmission and increased mortality. Longer treatment and hospital stays result in the increase in expenses for these patients. Bearing in mind the importance of health in the patient and economic factors, it is clear, that early diagnosis of the patient's nutritional status is extremely important [1].

In 2015, the European Society for Clinical Nutrition and Metabolism (ESPEN) presented new consensus criteria for the diagnosis of malnutrition. Three variables were selected to reflect malnutrition, i.e. weight loss, reduction in BMI and reduction in FFMI. Although weight loss can depend on the clinical condition of the patient, unintentional weight loss >5% in the last three months, with acute illness, or >10% of normal weight over an undetermined time, indicates the possibility of malnutrition. According to WHO recommendations, a BMI value <18.5 kg/m^2 can be used as a general determiner for underweight. In the case of FFMI, <15 kg/m^2 for women and <17 kg/m^2 for men can be used as an indicator of malnutrition [2].

These criteria will not always be useful. For example, in patients on peritoneal dialysis, the content of lean body mass decreases and chronic inflammation develops. These are symptoms of malnutrition- inflammation complex syndrome (MICS) or malnutrition- inflammation-atherosclerosis (MIA). Weight loss occurs in these patients, but as they are very often obese, malnutrition will not be reflected in their BMI and FFMI values [3]. In such situations, it would be helpful to check biochemical markers of malnutrition in order to diagnose malnutrition correctly and monitor the effectiveness of any nutritional treatment undertaken.

LABORATORY TESTS

Albumin

The usefulness of albumin determinations is increasingly questioned because of its long biological half-life of about 21 days. For this reason, it may be important in the diagnosis of chronic malnutrition, but it is of no use in diagnosing the development of malnutrition or in the assessment of any introduced nutritional intervention. In addition, hydration status affects the concentration of albumin, so results from people, who are dehydrated or who have severe burns will be unreliable. Maintaining the stability of albumin levels in the blood is influenced by its large pool in the intravascular space and the ease of mobilization of extravascular resources [4].

Prealbumin

Prealbumin is mainly synthesized in the liver. It is a transport protein that, by forming a complex with a retinol binding protein, mediates the transport of vitamin A. It also has the ability to bind and transfer thyroid hormones and certain drugs. A small pool of prealbumin in circulation (concentration 0.20-0.40 g/l in healthy people) and a short biological half-life of about two days make the determination of this protein useful in monitoring the effectiveness of nutritional treatment. The value of protein supply in pregnant women can be assessed based on prealbumin concentration, which in the case of shortages falls below the norm in the mother's blood and umbilical cord blood, correlating with low birth weight [5].

Transferrin

The main role of transferrin is the binding and transport of iron from enterocytes and liver cells to all cells of the body. The transfer of iron to the cells is mediated by specific membrane receptors- transferrin receptors (TfR). Compared to albumin, transferrin has a relatively short biological half-life of about 8 days, and its concentration in the blood serum of healthy people is 2.0-3.8 g/l. Although the level of transferrin is highly related to a person's nutritional status, due to its influence on the concentration of iron levels, some people question the usefulness of using this protein as a marker of malnutrition [6].

Retinol binding protein (RBP)

The main biological function of RBP is the binding and transport of vitamin A. It is synthesized in the liver as apoRBP, and after the attachment of retinol it is secreted into the circulation, where it forms a complex with transthyretin. Recent studies have shown that the ability to synthesize retinol-binding protein also has adipocytes (RBP4). It is believed that only about 4% of RBP circulates in free form, unrelated to prealbumin. Malnutrition, especially vitamin A deficiency, is associated with a reduction in the production and secretion of RBP from the liver. RBP concentration in the serum of healthy people ranges from 0.03-0.06 g/l, and the biological half-life is about 12 hours. Determinations of this protein, like prealbumin, have been used to monitor the effectiveness of nutritional treatment, in particular parenteral nutrition [7].

Insulin-like growth factor (IGF-1)

Insulin-like growth factor-1 is synthesized in most body tissues. Diet has a significant influence on the synthesis of IGF-1 along with growth hormone. A reduction in protein supply is associated with a decrease in the concentration of not only IGF-1, but also its main IGFBP-3 carrier protein. Over 90% of IGF-1 circulate in a form bound to this protein. Binding to IGFBP-3 prolongs the plasma half-life of IGF-1. The half-life of the IGF-1 / IGFBP-3 complex is about 12-15 hours, while the half-life of insulin, which has no carrier proteins, only 10 minutes. In healthy adults, the plasma concentration of IGF-1 is approximately 200 ng / ml. Determinations of IGF-1 have proved useful not only in assessing nutritional status, but also for monitoring nutritional treatment [8].

Calculated indicators of malnutrition and inflammation

The Nutrition Risk Index (NRI) has been identified as one of the most useful tools for assessing malnutrition in patients. NRI is based on two parameters: the concentration of serum albumin and weight loss. However, a normal body weight is required in order to weight loss to be assessed. This is a limitation for elderly patients because it is difficult to identify their correct weight. For this reason, the Geriatric Nutritional Risk Index (GNRI) has been developed as a new indicator for

assessing at-risk older medical patients. GNRI is based on two parameters: the concentration of serum albumin and the ideal body weight calculated using Lorentz or BMI equations. The formula is as follows: GNRI = 1.487 × serum albumin concentration (g/L) + 41.7 × pre-operative body weight / ideal body weight (kg). Previous studies have supported the use of GNRI due to its significant association with most nutritional parameters and short and long-term results. In addition, GNRI can explain both acute and chronic causes of malnutrition associated with underlying diseases and age-related factors [9].

The Prognostic Inflammatory and Nutritional Index (PINI) is a formula developed by Ingenbleek and Carpentier to assess nutritional status and prognosis in critically ill patients. It has been found that conventional nutritional assessments are insufficient for such patients and it has been proposed that inflammation may also affect nutritional status. PINI was created to take this into account. Ingenbleek also suggested that the PINI result can be used to track most pathological conditions. PINI has been measured in several settings and it has been found that it is a reliable indicator of both nutritional status and prognosis in injuries, burns, infected patients and patients with heart problems [10].

Prognostic results based on inflammation, such as the Glasgow Prognostic Score (GPS), have been predictive in patients with several types of advanced cancers. Although GPS is based only on C-reactive protein (CRP) serum and serum albumin levels (Alb), it may reflect systemic inflammation and nutritional status. CRP is the main indicator of inflammation, and hypoalbuminemia is related to malnutrition. These factors are associated with immunosuppression in cancer patients [11].

The control feeding result (CONUT) is calculated using serum albumin, total cholesterol and number of lymphocytes [13]. Serum albumin reflects the protein reserve, total cholesterol reflects the loss of calories, and the number of lymphocytes reflects immune defence. A higher CONUT indicates an inferior nutritional status. In patients with heart failure, the three-year survival with a CONUT score of 0-1, 2 and ≥3 was 95.5%, 92.3% and 73.2%, respectively ($p < 0.001$) [12].

CONCLUSION

Malnutrition is a problem not only as a separate disease, but also as a disorder that accompanies other diseases. It affects the duration of the other diseases, the effectiveness of their treatment and the survival of patients. For this reason, diagnosing malnutrition or its risk is very important because it determines the quality of subsequent treatment. In Poland, every person who goes to hospital is examined for malnutrition, excluding hospital emergency departments. Determination of biochemical markers of malnutrition may be helpful in diagnosing malnutrition in patients, especially when used in conjunction with other criteria, such as anthropometric measurements and BMI and FFMI values. These biological markers will be of greater use in the monitoring of nutritional treatment, since the values of some of them, e.g. prealbumin and transferrin, will quickly respond to any nutritional intervention due to their short half-life.

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ABBREVIATIONS

Alb – Albumin
BMI – Body Mass Index
CONUT – Control Feeding Result
CRP-C – reactive Protein
ESPEN – European Society for Clinical Nutrition and Metabolism
FFMI – Fat Free Mass Index
GNRI – Geriatric Nutritional Risk Index
GPS – Glasgow Prognostic Score
IGF–1 – Insulin- like Growth Factor-1
IGFBP-3 – Insulin- like Growth Factor Binding Protein- 3
MIA – Malnutrition- Inflamation- Atherosclerosis
MICS – Malnutrition- Infalmation Complex Syndrome
NRI – Nutrition Risk Index
PINI – Prognostic Inflammatory and Nutritional Index
RBP – Retinol Binding Protein
TfR – Transferrin receptor
WHO – World Health Organization

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